

WHAT IS CLAIMED IS:

1 1. An aeroelastic analysis system, the system comprising:
2 an input module configured to receive one or more input parameters associated
3 with aeroelastic characteristics of a structure; and
4 a neural network module coupled to the input module, and configured to generate
5 a transformation of the one or more input parameters to produce at least one aeroelastic analysis
6 result, the transformation based in part on a trained neural network.

1 2. The system of claim 1, further comprising an output module coupled to
2 the neural network module, and configured to output the at least one aeroelastic analysis result.

1 3. The system of claim 1, wherein the input module comprises at least one
2 input/output (I/O) device selected from the group comprising a keyboard, a keypad, a computer
3 mouse, a trackball, a button, a switch, a slides, a knobs, and a dial.

1 4. The system of claim 1, wherein the input module comprises at least one
2 input/output (I/O) device selected from the group comprising an electronic port, an electrical
3 connector, a receiver, a wireless receiver, an optical reader, an optical detector, a magnetic
4 reader, and a magnetic detector.

1 5. The system of claim 1, wherein the one or more input parameters
2 comprise:
3 a weight; and
4 a location of the weight on the structure.

1 6. The system of claim 1, wherein the neural network module comprises:
2 a weight vector module configured to multiply the one or more input parameters
3 by a weighting vector to generate one or more weighted parameters;
4 a bias module configured to provide a scalar bias value;
5 a summer coupled to the weight vector module and the bias module and
6 configured to output a sum of the one or more weighted parameters and the bias value; and
7 a transfer function module coupled to the summer and configured to apply a
8 transfer function to the sum.

- 1 7. The system of claim 6, wherein the transfer function comprises a non-
2 linear transfer function.
- 1 8. The system of claim 6 wherein the transfer function comprises a tangent
2 sigmoid function.
- 1 9. The system of claim 6, wherein the transfer function comprises at least
2 one function selected from the group comprising a sigmoid, a hyperbolic tangent sigmoid, a
3 logarithmic sigmoid, a linear function, a saturated linear function, and a radial basis function.
- 1 10. The system of claim 1, wherein the at least one aeroelastic analysis result
2 comprises a flutter frequency at a damping value.
- 1 11. The system of claim 1, wherein the at least one aeroelastic analysis result
2 comprises a flutter speed at a damping value.
- 1 12. The system of claim 1, wherein the at least one aeroelastic analysis result
2 comprises a flutter frequency and a corresponding flutter speed at a damping value.
- 1 13. The system of claim 1, wherein the at least one aeroelastic analysis result
2 comprises a contour plot of store loadings.
- 1 14. An aeroelastic analysis system, the system comprising:
2 an input module configured to receive a weight and a location of the weight on a
3 structure; and
4 a neural network module coupled to the input module and configured to provide
5 the weight and location as inputs to a trained neural network having at least two neurons to
6 determine a flutter speed and an associated flutter frequency based in part on the weight and
7 location.
- 1 15. The system of claim 14, wherein the location of the weight is selected
2 from a predetermined number of locations on a structural model.

1 16. The system of claim 14, wherein the weight comprises a weight less than a
2 predetermined maximum weight.

1 17. A method of performing aeroelastic analysis, the method comprising:
2 determining input parameters;
3 determining a training set of characteristic I/O pairs;
4 generating a neural network;
5 training the neural network using the training set to generate a trained neural
6 network; and
7 determining aeroelastic characteristics of a structure based in part on the trained
8 neural network.

1 18. The method of claim 17, further comprising determining an accuracy of
2 the aeroelastic characteristics determined using the trained neural network.

1 19. The method of claim 17, further comprising:
2 determining a weight vector in the trained neural network; and
3 determining a bias value in the trained neural network.

1 20. The method of claim 19, wherein determining the aeroelastic
2 characteristics comprises:
3 multiplying received input parameters by the weight vector to generate weighted
4 parameters;
5 summing the weighted parameters and the bias value to generate a summed input;
6 and
7 applying the summed input to a transfer function associated with a neuron in the
8 trained neural network.

1 21. A method of performing aeroelastic analysis, the method comprising:
2 receiving at least one input parameter related to an aircraft structure;
3 applying a predetermined neural network transfer function to the at least one input
4 parameter to generate an aeroelastic analysis result; and
5 outputting the result.

- 1 22. The method of claim 21, wherein receiving at least one input parameter
2 comprises:
3 receiving a weight; and
4 receiving location of the weight on the aircraft structure.
- 1 23. The method of claim 21, wherein applying the predetermined neural
2 network transfer function comprises:
3 multiplying the at least one input parameter with a weight vector to produce at
4 least one weighted input parameter;
5 summing together the at least one weighted input parameter and a bias value to
6 generate a summed value; and
7 applying a neuron transfer function to the summed value.
- 1 24. The method of claim 21, wherein the aeroelastic analysis result comprises
2 a flutter speed at a damping value.
- 1 25. The method of claim 21, wherein the aeroelastic analysis result comprises
2 a flutter frequency at a damping value.
- 1 26. The method of claim 21, wherein the aeroelastic analysis result comprises
2 a flutter speed and an associated flutter frequency at a damping value.
- 1 27. The method of claim 21, wherein the aeroelastic analysis result comprises
2 a contour plot of store loadings.
- 1 28. One or more processor readable instructions stored in one or more storage
2 devices, the one or more processor readable instructions, when executed by a processor
3 instructing the processor to perform the method comprising:
4 receiving at least one input parameter related to an aircraft structure;
5 applying a predetermined neural network transfer function to the at least one input
6 parameter to generate an aeroelastic analysis result; and
7 outputting the result.

1 29. One or more processor readable instructions stored in one or more storage
2 devices, the one or more processor readable instructions, when executed by a processor
3 instructing the processor to perform the method comprising:

4 receiving a mass input;
5 receiving a location of the mass on an aircraft structure;
6 multiplying the mass input and location with a weight vector to produce weighted
7 input parameters;
8 summing together weighted input parameters and a bias value to generate a
9 summed value;
10 applying a neuron transfer function to the summed value to generate an
11 aeroelastic analysis flutter result; and
12 outputting the flutter result.

1 30. An aeroelastic analysis system, the system comprising:
2 means for receiving input parameters;
3 means for applying a neural network transfer function to the input parameters to
4 generate an aeroelastic analysis result; and
5 means for outputting the result.